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ABSTRACT

This publication presents the activities pertaining to the second goal of this activity guide series. The activities in this publication focus primarly on awareness, conservation, and planning. These materials are appropriate for middle school and junior high school students. These activities, organized by objective under the concepts listed, are interdisciplinary and can be used in many ways. The activities are simply ideas of things that students can do to help them understand the concepts. It has been left for the teacher to choose and implement these ideas as desired. Activities range from writing a story that details the impact on members of a food chain when one member is removed to conducting a community survey to determine how people are trying to conserve energy. (MR)

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USES of energy

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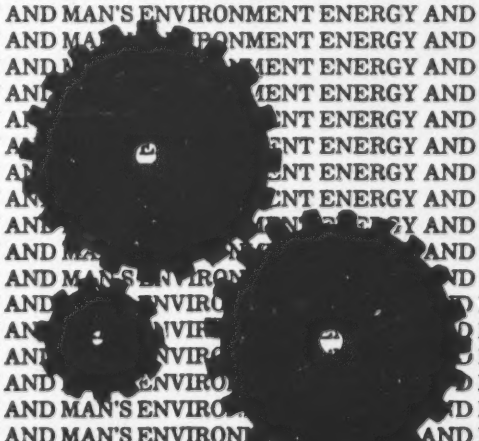

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ENERGY AND MAN'S ENVIRONMENT

Activity Guide

An Interdisciplinary Teacher's Guide to

Energy and Environmental Activities

Section Two

USES OF ENERGY

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USES OF ENERGY

Introduction

Since energy is the capacity to do work it is an essential part of all processes: biological, physical, and socioeconomic. All living things require energy input.

Our present technological society uses three times the energy required by 19th Century industrial man and ten times that required by the advanced agricultural societies of 13th Century Northern Europe. We now use 25-30% of our energy for transportation, over 30% for household and commercial purposes and the remainder for industrial production.

The demand for energy has been growing at an exponential rate. So rapid has the use of energy been that it exceeds the population growth rate by fourfold; resulting in significant per capita consumption increases. Electric power generation has been growing at 7-10% per year. The trend toward more electricity tends to reduce the overall efficiency of the system (see **CONVERSION OF ENERGY**) by substituting a thermal efficiency of 30-40% for direct fuel uses with efficiencies of up to 90%. Air conditioning alone represents over 15% of the total increase in electric power generation in the early 1970's.

The shift toward more non-durable (disposable) goods and high-horsepower automobiles had measurable effects on the rate of energy use. The U.S. with about 6% of the world population requires about 35% of the global output and produces more than 50% of the consumer goods.

Clearly social, economic and political realities influence the use of energy. Increased conversion efficiencies (technology), conservation at the users end (like cooler rooms, less light, better insulation, fewer throw-away items, smaller automobile engines, and better public transportation), as well as future sources will have an effect. Cost is also looming as an important factor.

Awareness is beginning to develop among knowledgeable people that they are absolutely dependent on energy and that they must develop strategies to adjust to the changing lifestyles dictated by the passing of the era of energy over-use. Foremost will be the question of the real relationship between "standard of living" and the quality of life and the "net" cost of energy production and use.

The activities in this section focus on awareness, conservation, and planning. for greater personal involvement in decision-making.

Dan Horn

EVALUATION

Uses of Energy

The ENERGY and MAN'S ENVIRONMENT program actively seeks your ideas, comments, and general suggestions about this Activity Guide. If you feel there are ways this Activity Guide could be improved, or if more or different learning objectives or activities could be added, please let us hear from you. We plan to contact you in the near future to ask your opinion about the activities which you have used in your classroom. In anticipation of our request, we ask that you keep a careful record of all specific activities which are tried in your classroom. Please rate the effectiveness of each activity according to the following scale.

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 highly effective 4 5	Comment Suggestion
			EXAMPLE		
Sources	III	B	2	✓	students enjoyed very much
Sources	III	B	5	✓	students enjoyed very much
Uses	II	A	3	✓	too difficult for age level

EVALUATION Uses of Energy

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion

EVALUATION Sources of Energy

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion

EVALUATION Sources of Energy

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion

concept: I - All living things and natural processes require energy.

uses

objective: A - The student will simulate a food chain or food web.

activities

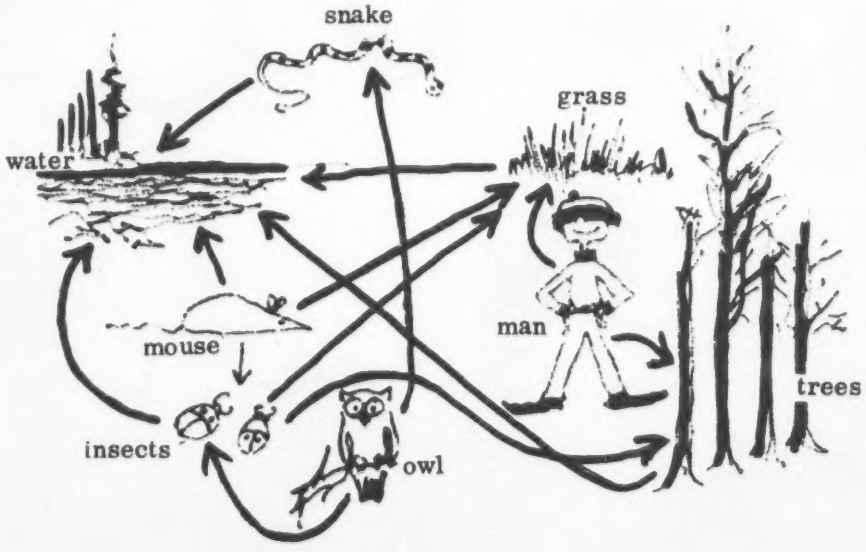
1. Diagram a simple food chain and discuss the interdependence of the trophic levels. Discussion should include the flow of energy and nutrients through the system.

2. Collect pictures from nature magazines and construct a collage illustrating a simple food web.

3. Write an original story detailing what happens to the other members of a food chain when one member is removed.

4. Obtain a camera and take pictures of the members of a food chain in your local environment. Make a bulletin board display of all your work.

5. Conduct a scavenger hunt and collect natural materials in a sack. Using colored marking tape or string, connect the different objects with string on the basis of their relationships to each other. Relationships might include: shelter, food, etc. Discuss each relationship with the students to illustrate the idea of a web of life. Then introduce humans! Do the relationships change? Finally, cut one of the strands and discuss what effect it has on the whole system.



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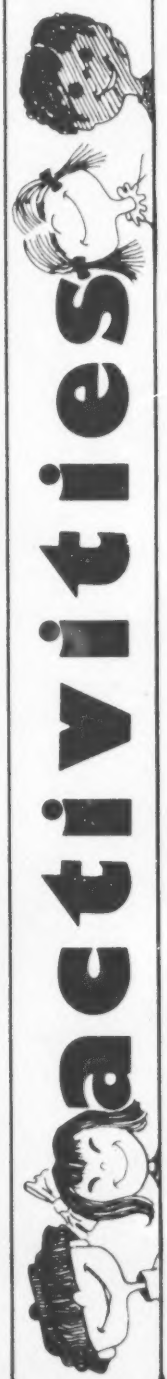
concept: I - All living things and natural processes require energy.

uses

objective: B - The student will know that energy is necessary for growth.



activities

1. Plant two terrariums with grass and place one in the light and one in the dark. After two weeks observe the differences in growth. If you have a good scale, clip the vegetation, dry and compare the dry weight.

2. In the spring observe the types, size and color of plants found on the north side of a building. Compare these types of plants with those found on the south side of the building. This activity may also be done with plants on the north and south side of a tree.

3. Take a series of polaroid pictures of a growing plant over a period of time and construct a bulletin board illustrating growth rate.

4. Chart your food consumption for five days and with a caloric chart calculate your calorie intake.

5. Make a bulletin board displaying different kinds of food and their caloric content.

6. Design an experiment to compare energy intake and growth in a small baby, a teenager and an adult.

   Note: How much of the energy that goes in is used for growth?

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concept: I - All living things and natural processes require energy.

uses

objective: C - The student will understand that all non-living natural processes require the input of energy.

activities

1. Illustrate the hydrologic cycle by constructing a terrarium with a closed top and one without a top; compare the humidity, temperature and plant growth over a period of time in each terrarium.
2. Light a birthday candle. Observe what happens to the flame when the wick and wax are gone.
3. Make a poster using a diagram of the hydrologic cycle. Indicate the points where energy enters the cycle.
4. Make a mural illustrating the energy sources for natural geophysical process such as volcanoes, geysers, hot springs, landslides, currents, earthquakes, erosion, etc.

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concept: I - All living things and natural processes require energy.

uses

objective: D - The student will understand how and why living things store energy.

activities

1. Take a sugar cube and rub it in some fire ashes (the necessary catalyst). Light it with a match. Make a list of organisms that store energy as sugar.

2. Draw a map of your home showing all the places food is stored. Select five animals and five plants and tell where they store food.

3. Test several foods such as soda crackers, potatoes, carrots, lettuce, for the presence of starch (energy) by staining with iodine.

   Note: A dark black color indicates the presence of starch.

4. Raise bean plants until cotyledons are above the ground. Remove the cotyledons. Use aluminum foil to cover half of the leaves on each plant. After two weeks remove all the leaves. Dry both sets of leaves until they are completely dry by placing them in sunlight for a week.

   Weigh or measure the area of both sets of leaves. Burn the leaves on a screen to demonstrate their use as a fuel.

5. To show stored energy, take several leaves from a coleus or geranium and diagram the color patterns. Then boil the leaves in alcohol to remove the green pigment. Place the leaves in a dish and cover them with an iodine solution (IKI). Remove and compare with the original drawing.

   Note: Stained areas (black) indicate presence of starch and should coincide with the green area on the original drawing, indicating the need for chlorophyll for photosynthesis to take place.

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concept: I - All living things and natural processes require energy.

uses

objective: E - The student will understand how different organisms get their energy.

1. Construct a mobile depicting a herbivore, carnivore, and omnivore in food gathering activities.

2. Obtain from the teacher a film catalog. Order a film which tells how plants and animals get their food and show it to the class.

3. Where do plants get their energy before they produce leaves?

   a. Soak six bean seeds in water for 24 hours.
   b. Weigh the seeds and record the weight.
   c. Plant seeds in a flat.
   d. When they sprout, remove the shoot and root and weigh the seed again.

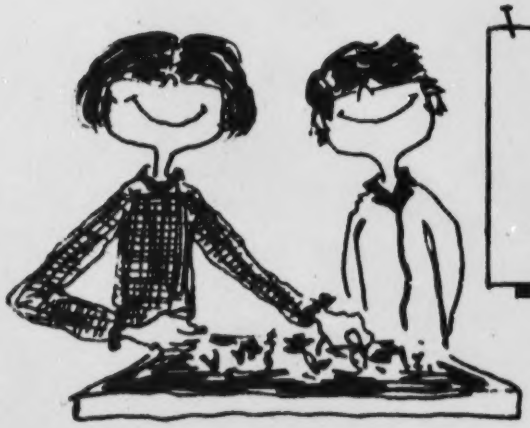
4. Place several 3 - 4 inch tall pea or bean plants in a dark closet and on the window sill. After one week record the difference in color and growth.

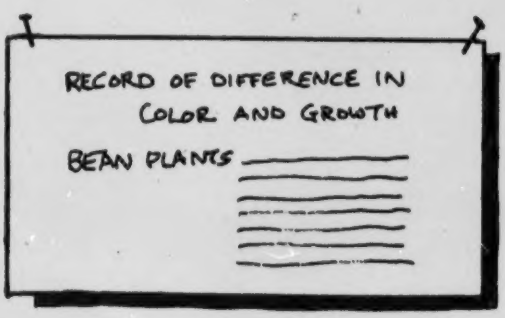
5. Place the skulls of several mammals on a table and divide them into three groups on the basis of their food getting adaptations.

   Note: What kinds of teeth are present?

6. Place several stuffed birds on a table and group them on the basis of what type food they eat.

   Note: Compare beak size and shape and type of feet.





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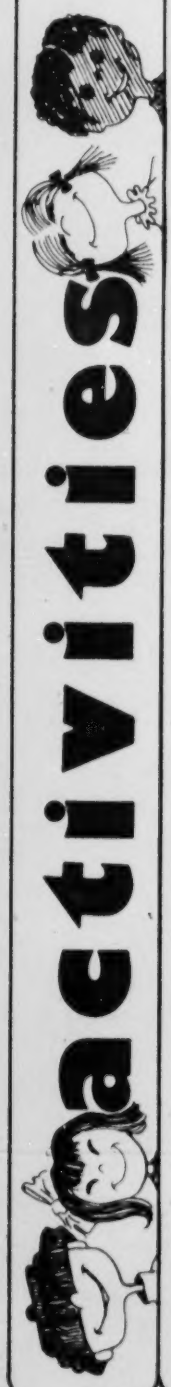
concept: II - Each form of energy can be used in many ways.

uses

objective: A - The student will understand that fossil fuels and other natural resources have both energy and non-energy applications.



activities

1. Organize a panel to discuss these issues: Should mankind consume petroleum as a source of chemicals to produce synthetic materials?

   Who should make the control decisions on that issue? What are the alternatives? Should we also be concerned about the energy needed to produce natural materials such as wool and cotton?

2. List five products made from crude oil and indicate how they are used.

3. Make a list of the materials in your home that are made from petroleum.

   Prioritize your list on the basis of which products you can do without, if and when the source of petroleum is depleted.

4. Visit a hospital, research facility or university and tour their facilities set up for non-energy uses of nuclear science.

5. Write to the Energy Research and Development Administration, Technical Information Center, P.O. Box 62, Oak Ridge, Tenn. 38320, or Director of Public Information, Energy Research and Development Administration, Richland Operations Office, P.O. Box 550, Richland, Wash. 99352, for information on: radioactive tracer techniques, neutron radiography, radiation therapy, auto radiographs. Use this information to make a report.

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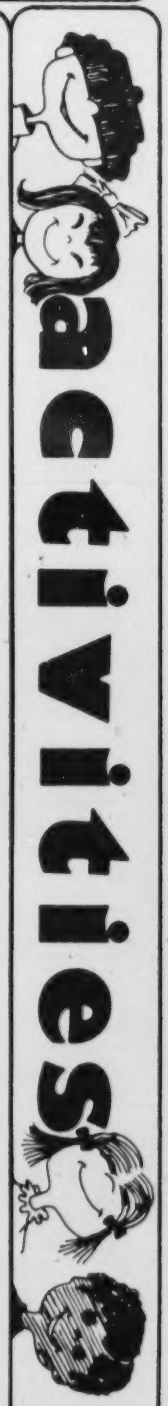
concept: II - Each form of energy can be used in many ways.

uses

objective: B - The student will understand ways in which different energy sources may be used.

activities



1. Describe common food and toiletry packages and containers, listing energy sources required to produce them.

2. Diagram a fluorescent tube and explain how it works, contrasting its electric light and heat output to that produced by other types of lamps.

3. Divide a 9" x 12" piece of paper into three sections. In each section, using pictures from magazines or sketches, depict three ways wind is used as a source of energy.

4. Inventory your home block (teacher will provide data sheet for primary grades) to determine the percentage of homes using the various types of energy - coal, oil, natural gas, electricity for water heating, space heating, and cooking.

   Report findings on a bar graph.

5. Draw a picture showing your home's use of coal, oil, natural gas and electricity.

6. List four uses for each of the following fuels: wood, coal, natural gas, oil.

7. Describe the different environmental demands between a subtropical city like Miami and a northern city like Minneapolis.

8. Diagram and discuss at least two methods of space heating, such as oil, gas and electric, including forced air, baseboard and hot water heat transfer methods.

9. Construct a simple radio and describe the sources of energy that could be used to operate it.

10. Diagram and discuss the operation of the steam turbine, such as those found in steam-electric plants.

11. Diagram an incandescent light bulb and a vapor lamp, describing how each works. Contrast their respective outputs of electric light and heat to those produced by other types of lamps, such as fluorescent tubes.

12. Discuss what is meant by a country's "energy mix".

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concept: II - Each form of energy can be used in many ways.

uses

objective: C - The student will understand that some energy resources and applications may be used in ways that are more aesthetically pleasing than others.

activities

1. Design what you consider to be the most aesthetically acceptable form of energy for efficient housing. Justify your choice.

2. Write a letter to the electric utility serving your home. Ask about costs to change from overhead to underground wiring, and ask about the company's policy on such changes. Compare costs to those necessary when installing underground wiring at the time of initial construction.

3. Describe the advantages of vacationing in the wilderness. Does the use of trail bikes, snowmobiles, motorcycles, campers, etc., improve or impair such activity and why?

4. Identify what you consider the "ugliest" site or object in your city. Estimate the amount and type of energy used in its creation. Take pictures and record that site or object. Conduct an ugly site or object contest to determine the worst.

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concept: II - Each form of energy can be used in many ways.

uses

objective: D - The student will know how energy is used at home, at school, and in the broader community.

activities

1. Inventory your belongings and list those acquired during the past two years which use energy. List those things you would like to acquire.

2. Pretend that a major disaster has hit the community. Sources of electric power and water have been damaged. Describe the activities of your family under these circumstances. Underline each activity that is normally performed by power, e.g. chopping and burning wood for heat, purifying water, etc.

3. Write a letter to the manufacturer of one of the electrical appliances found in your home, asking for information about the source of the materials used in its manufacture.

4. Identify any wood products used as a direct energy source in your home.

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concept: II - Each form of energy can be used in many ways.

uses

objective: E - The student will understand how engines use energy.

activities

1. Plastic models exist for demonstrating the internal-combustion and rotary engines. Compare these engines for efficiency in horsepower, parts. Compare to the jet engine turbine to show mechanical parts, efficiency horsepower.

   One cylinder internal-combustion engines are made for model airplanes. Operate one in class to show principles and to collect polluting gas. Test gas from combustion by air pollution experiments for junior and senior high schools.

   Compare gas motor to batteries and A.C. from wall socket by attaching each to an electric motor. The motor will do work which is measured, e.g. lifting weights. Windmill may be attached to same.

2. Diagram and describe the operation of the diesel engine.

3. Diagram and describe the operation of the internal-combustion engine.

4. Draw plans and make a windmill that works.

5. Describe both present and historical uses of the windmill.

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concept: II - Each form of energy can be used in many ways.

uses

objective: F - The student will understand that energy use follows a path from source to ultimate destination.

activities

1. Show how major energy fuels are transported to users and how energy is used in doing so.
   a. Find pictures to show transportation.
   b. Draw diagrams to show energy used by each form of transportation.
2. Trace the path of electric power from fuel origin to your home fuse box.
3. Construct an electrical circuit and explain how it works.
4. Select appropriate music and create a dance depicting the energy path of a thunderstorm.
5. Build a 3-D model of the network involved in getting electricity from a hydroelectric dam to your home.
6. Take pictures with a camera of the energy transportation network operating in your local community.
7. Place a string upon a map connecting energy sources with your city. Write a paragraph describing the process of energy movement into your community.

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concept: III - All industrial processes make use of several forms of energy.

uses

objective: A - The student will understand that some forms of energy are more efficient and more applicable to certain uses than are others.

activities

1. Visit a phone company and observe the various ways energy is used. List all the energy devices you use.
2. Study the way steel is made and identify the forms of energy used in that process.
3. Compute the various energy bills for your school for one month using last year's audit. To determine the percentages involved use a ratio of the students in your school with total student population in the district. (Have one student collect the materials.)
4. Visit a local industry to determine the amount of energy in various forms that are used. Take into consideration energy to run the machines, energy to transport and extract raw materials, energy to light the plant, human energy, climate control, transportation for finished product, packaging, merchandising, and the energy used by the consumer in purchasing the product. Estimate the percentages involved.
5. Construct a mural illustrating the diversity of uses indicated above.
6. Use the above data to design a more efficient system of energy utilization taking into consideration such things as recycling and retrieving waste heat.
7. Compare the forms of energy used by several different industries in your community.
8. Visit the local historical society or library in your community to determine if the forms of energy used in the past are still used today, and determine the extent of use of each form of energy.
9. Try to produce some work of art or utilitarian object utilizing more than one form of energy. Determine the compatibility and efficiency of each form of energy to do the job.
10. Discover the reasons why different types of fuel are used in different types of engines used in the transportation industry: diesel, natural gas, propane, leaded gas, non-leaded gas.

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concept: IV - Some human technologies and activities use more energy than others.

uses

objective: A - The student will understand that different amounts of energy are used in the production of everyday items in the environment.

activities

1. List five high use and five low use technologies.

2. Take a field trip or write a letter to an industrial plant in your area. Find the plant's use/day of electricity and other forms of energy which it uses. Describe the plant process. Discuss the output product, its use and its importance to society.

3. Work in a small group to "manufacture" articles or art objects, and record all types and uses of energy involved in the process.

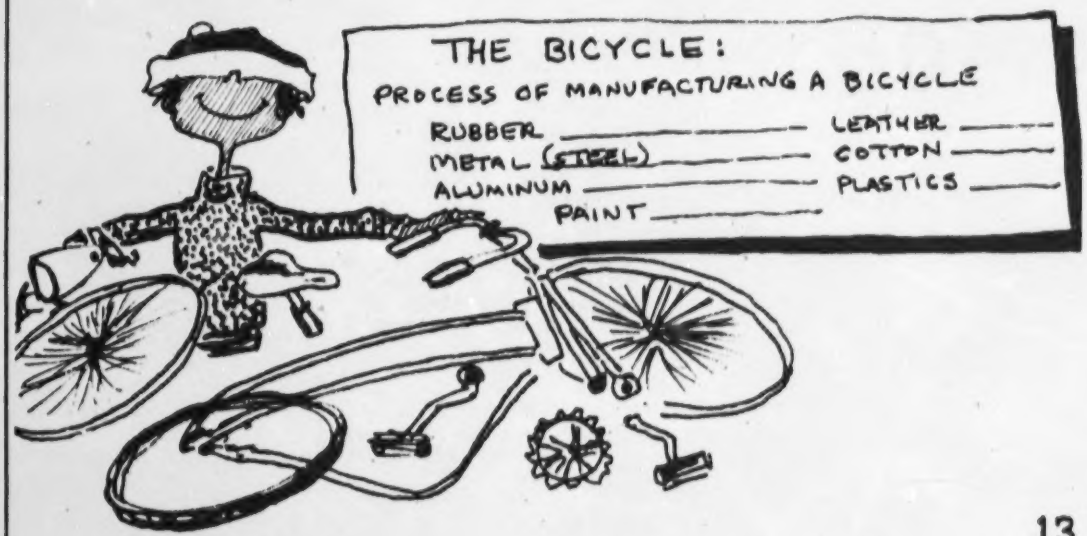
   Suggested items for manufacture:

   a. Candles - wax, molds, wicks, coloring agents, and candle holders.

   b. Clay beads - formation of clay, firing, stringing, pigment preparation, and finishing.

   Think of various alternative projects. If articles were to be used as items at a bazaar, more processes would be involved; this activity might be included in an economics unit where real profits and losses could be experienced.

4. Describe the process of manufacturing a bicycle, including all energy sources.



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concept: IV - Some human technologies and activities use more energy than others.

uses

objective: B - The student will understand why some technologies use more energy than do others.

activities

1. Divide the class into at least three groups. Each group will draw a mural depicting the different types of transportation systems which exist in their area. Arrange for each group to visit its transportation system to gain first-hand knowledge, then determine the amount of energy used by each.

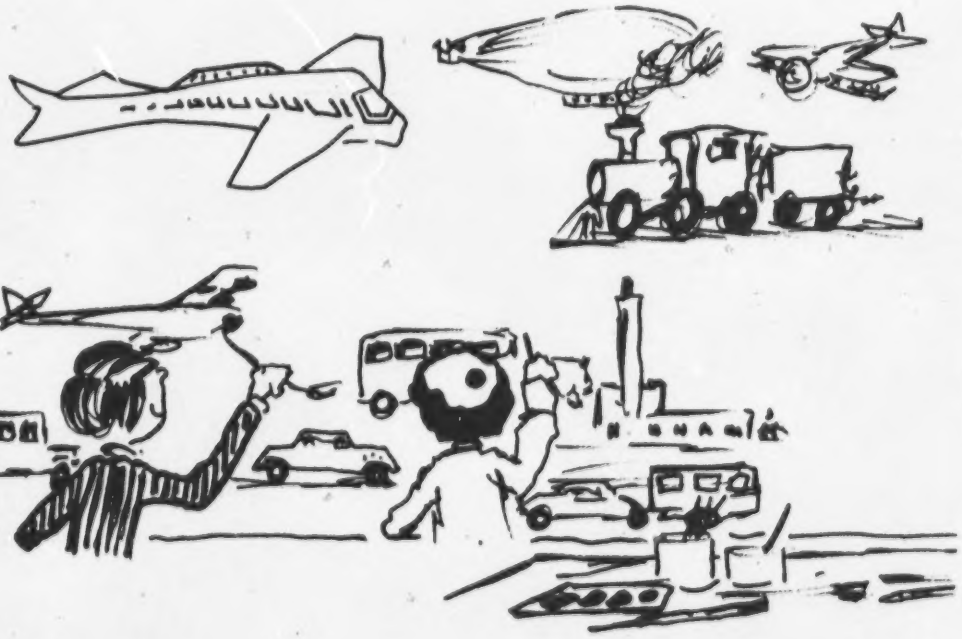
2. Calculate the proportion of power used in your city by industrial, commercial and residential users. Compare the proportionate power use of a large city with that of a small one.

3. List several of the largest industrial users of electricity.

4. Describe the quantities of energy used by basic manufacturing industries such as aluminum, iron, copper, etc.

5. Determine the different uses of energy in your home and rank them from highest to lowest use.

   Determine by democratic vote which item will have to go when energy becomes short.



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concept: IV - Some human technologies and activities use more energy than others.

uses

objective: C - The student will understand that availability of ample energy resources has produced high energy use technologies.

activities

1. Contact your local electric power company. Find out which are the highest electric energy using technologies in your community and in the power company's total area of service.
2. Obtain from your local power company a graph showing the amount of power they have produced during the past 20 years and any explanations for large fluctuations that might have occurred.
3. Locate on a map of the U.S. the areas where high energy use technology is grouped. Correlate the geographic position to the available energy sources.
4. Explain why Venezuelan bauxite is processed on the Columbia River.

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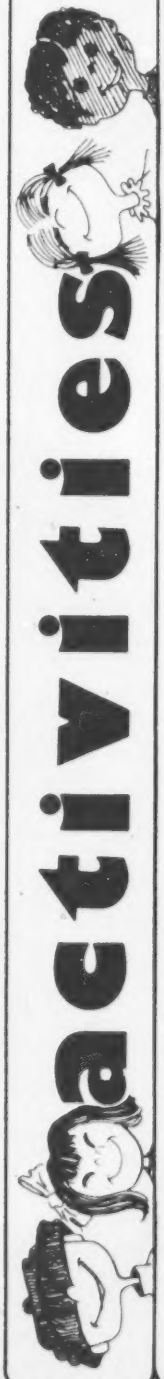
concept: IV - Some human technologies and activities use more energy than others.

uses

objective: D - The student will learn that decisions to allocate future energy resources and to build future technologies may be based upon economic, aesthetic, political and social judgments.



activities

1. List and discuss ways in which your community could use future energy resources to beautify the city.

2. Pick a favorite area in your community and take a polaroid picture of the area. Draw a picture of what the area could look like if the city fathers decided that aesthetics were the most important deciding factor.

3. Make a list of technologies now based upon fossil fuels that will in the future be unable to switch to other energy sources.

4. Redesign three products now in existence with the intention of making them more aesthetically pleasing and more efficient users of energy.

5. Speculate upon four new social services that may become available in our society in response to increased and/or decreased energy supplies.

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concept: IV - Some human technologies and activities use more energy than others.

uses

objective: E - The student will know and work with the basic units of energy measure.

activities

1. Contrast the energy units required per passenger mile for each major form of transportation - automobile, bus, plane and train.

2. List the number of light bulbs in your home and their wattage. During one evening, you should note the time each light is turned on and when it is turned off, and from from this data calculate the kilowatt hours used by these light bulbs.

3. Compare the gasoline mileage of various automobiles.

4. Put together a collage using energy terms and illustrations found in newspapers and magazines.

5. Construct a simple generating device and measure the amount of power produced.

   Procedure: Wrap a large nail tightly with electrical wire, leaving both ends of wire hanging free. Attach each end of wire to one of the leads from voltameter. Pass wire-wrapped nail very quickly back and forth between poles of magnet. The amount of voltage potential generated should be registered on the voltameter.

   Materials: Large "C" shaped magnet; large iron nail; electrical wire; voltameter.

6. Arrange, in order, the number of kilowatt hours per unit, utilized by the following industries: pulp and paper, plywood, chlorine and caustic chemicals, iron and steel, phosphate fertilizers, and aluminum.

7. Read your home watt-hour meter and school watt-hour meter daily for one week or month. Discuss the comparative energy consumption. Graph the results.

8. Select an art object, preferably sculpture, and determine the kinds of energy used to produce it. Estimate the amount of energy used by the artist. Use calorie charts to determine the energy for a man at work.

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activities

Concept IV
Objective E

9. Calculate the energy required to move your body weight one mile by walking; contrast with energy required to move one mile by bicycle or one mile by automobile. (Include the energy required to manufacture the vehicle.)

10. Create a comparative graph of cost of living and cost of electricity/ Kwh.

11. Define the units of measure which are applied to energy consumption in the home.

ENERGY REQUIRED TO MOVE YOUR BODY ONE MILE — BY WALKING - BY BICYCLE - BY AUTOMOBILE:

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concept: IV - Some human technologies and activities use more energy than others.

uses

objective: F - The student will understand how man has used energy throughout history.

activities

1. Compute the energy requirement of a northwestern family to maintain two horses for a year and an automobile for a year.

2. Using Figure 1 as the source of data and means for comparison, answer each of the following questions:

True or False

____ 1. During the period between 1870 and 1970 there was an increase in the amount of energy used in the United States.

____ 2. During the period between 1870 and 1970 the amount of wood fuel used in the United States decreased.

____ 3. It could be generalized that the amount of coal used for energy between 1870 and 1970 decreased.

____ 4. During the period between 1910 and 1930 there was a lesser increase in energy consumption than between 1930 and 1970.

____ 5. During 1970 the amount of energy used nearly equaled the total amount used in both 1930 and 1950.

Complete the following statements:

6. The primary source of fuel in 1910 was _____.

7. In the year _____, wood fuel was the primary source of energy.

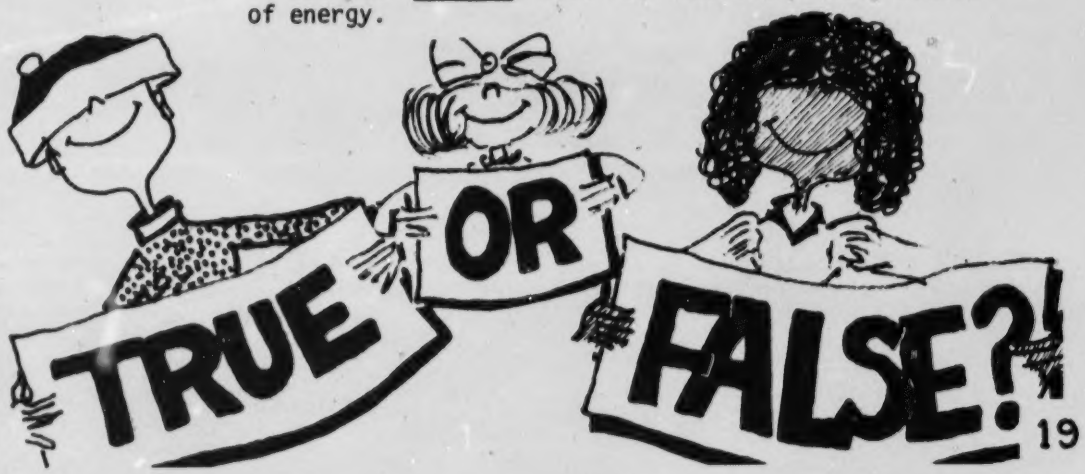

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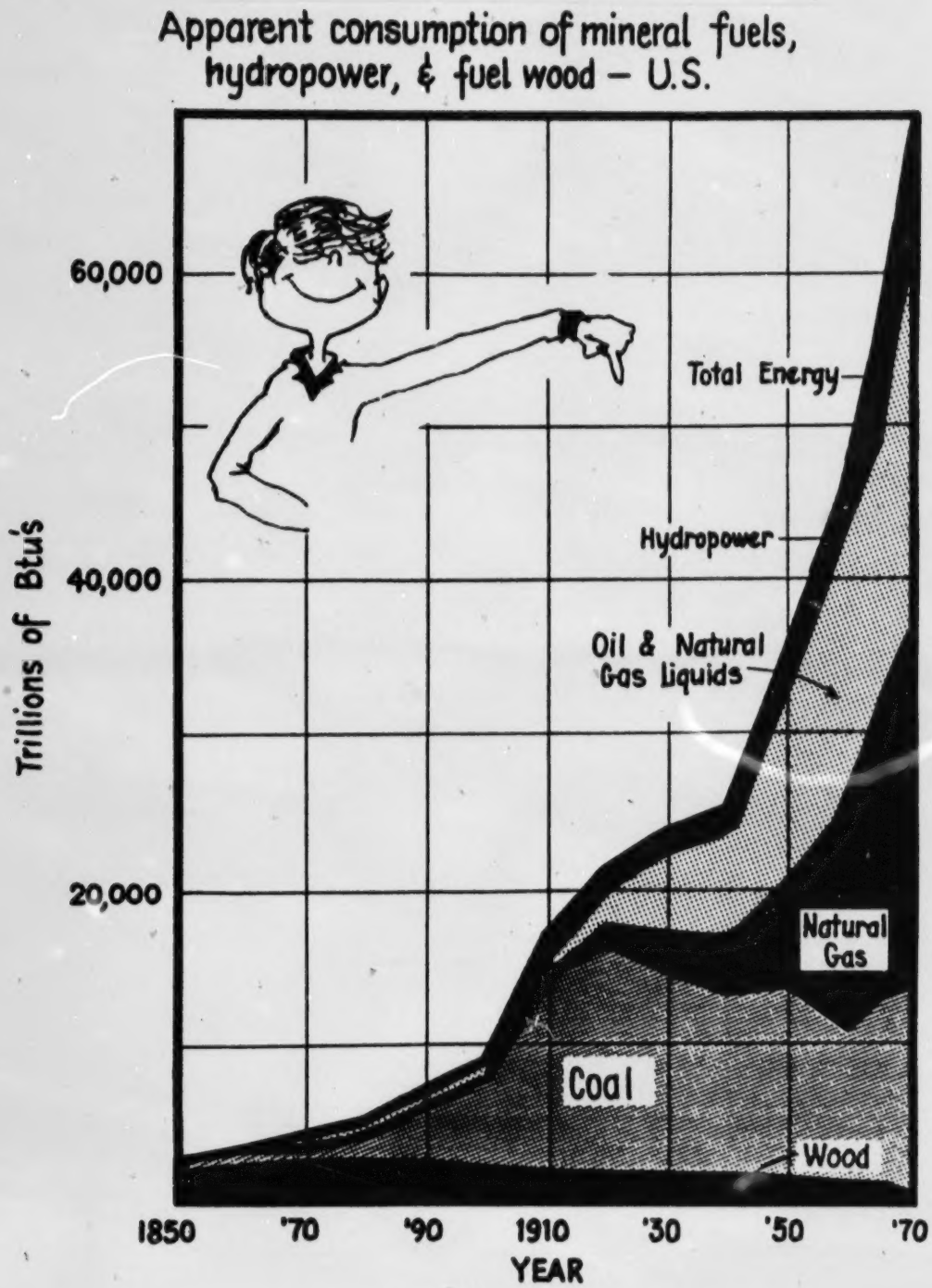
FIGURE No. 1



The Electric Energy Picture in the Pacific Northwest. U.S. Department of Interior, Bonneville Power Administration, April 1, 1973.

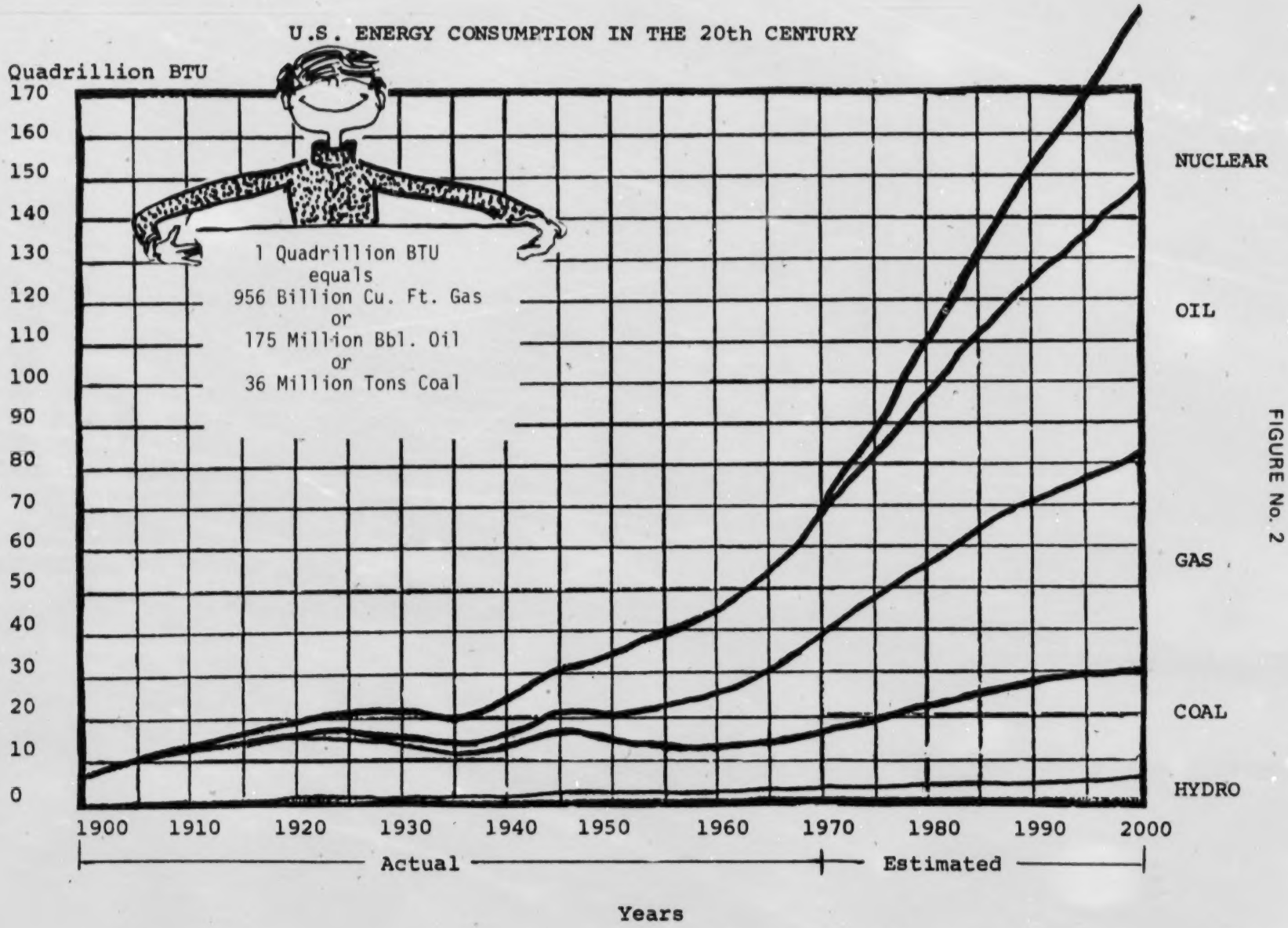


FIGURE No. 2

Department of Interior
March, 1971

activities

Concept IV
Objective F

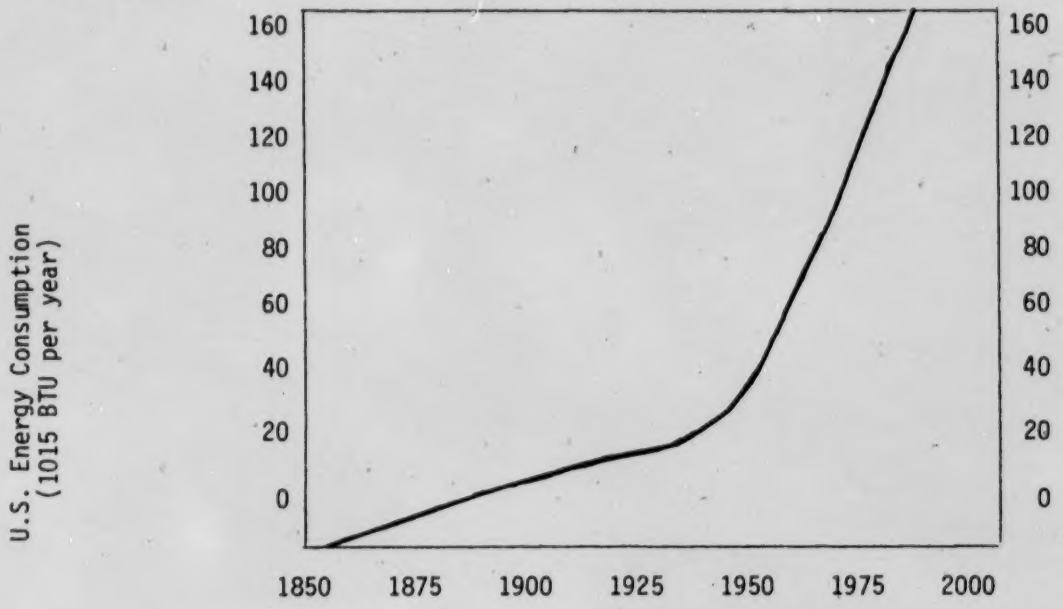


Figure 1 - U.S. Energy Consumption
(From U.S. Bureau of Mines)

3. Using the graph, respond to the following:

   a. Select the year 1925 and compare the U.S. energy consumption that year with 1900 and 1950.

   b. Compare 1975 to 1950.

   c. How would you use the chart to find the energy consumption in 1960, 1970, and this year?

   d. About which year did a marked increase in energy consumption begin? How would you account for the increase then?

   e. Check the U.S. population for the year that you chose in d. above. How does this help explain the increased consumption?

   f. What will happen if we use energy at the predicted level beyond 1975? What would happen if all other people in the world were to achieve the same level of energy consumption?

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activities

Concept IV
Objective F

4. From the following items, list the energy consumed by each in its production and in its use. If you had to cut your energy consumption drastically, which of these could you replace easily? Which would be more difficult? Which would be impossible?

electric lighting	prefab house
electric cooking	aluminum siding
electric heat	power lawn mower
water heating	steam shovel
air conditioning	electric toothbrush
mixer	power saw
washer	plastic modular furniture
dryer	dishwasher
synthetic fiber clothing	television
wood frame house	radio
automobile	stereo system
stop lights	road graders
street lights	tractors

5. On separate pie charts, compare the consumption of oil, coal and other energy sources by industry, agriculture, government, etc.

6. Using the charts on page 111 of "The Biosphere", Scientific American, W.H. Freeman Co., 1970, prepare a chart showing the probable duration of the use of coal, oil and natural gas if future use is at the 1970 rate; then at the year 2000 rate.

7. Make a mural which describes the historical progression of fuel uses from wood to nuclear fuel based on man's progressive technological abilities. Include wood, peat, lignite, coal, oil, natural gas, nuclear fission and nuclear fusion.

8. Map the voyage of Ra. Discuss the implications of wind and water power (currents) to world settlement.

9. List five reasons why stores and offices today use almost twice the electric energy as they did ten years ago.

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activities

Concept IV
Objective F

10. Make a bar graph comparing the residential and industrial consumption of oil, natural gas and electricity.

    Given the data from BPA 1971 Status Report:

Energy Sales (Billions of KWH)	Actual			Projected	
	1950	1960	1970	1980	1990
Domestic	5.5	13.8	27.5	47.5	77.7
Commercial	2.4	5.2	12.1	22.5	38.3
Industrial	11.1	22.3	44.1	74.7	118.0

    a. Graph the data.

    b. Estimate from the graph the percentage of use by Domestic, Commercial and Industrial in 1970.

    c. Consider how adverse weather conditions affect energy consumption.

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concept: V - Every decision made involving energy affects standards of living.

uses

objective: A - The student will understand the concept of a high standard of living.

activities

1. By interviewing other people, find out what the "good life" is as seen by students and what it is as seen by adults.
2. Construct a model society that constitutes the "good life", which can be used as background for making judgments concerning energy-resource use, considering both yourself and others. (This can be done by having a stranger visit an inhabited island.)
3. Discuss the social implications of the energy-use imbalance in the world today.
4. List at least five energy sources on which you depend from the time you awaken until your class begins.
5. Describe five ways electric energy has enriched your life.
6. Discuss the political implications of the energy-use imbalance in the world today.

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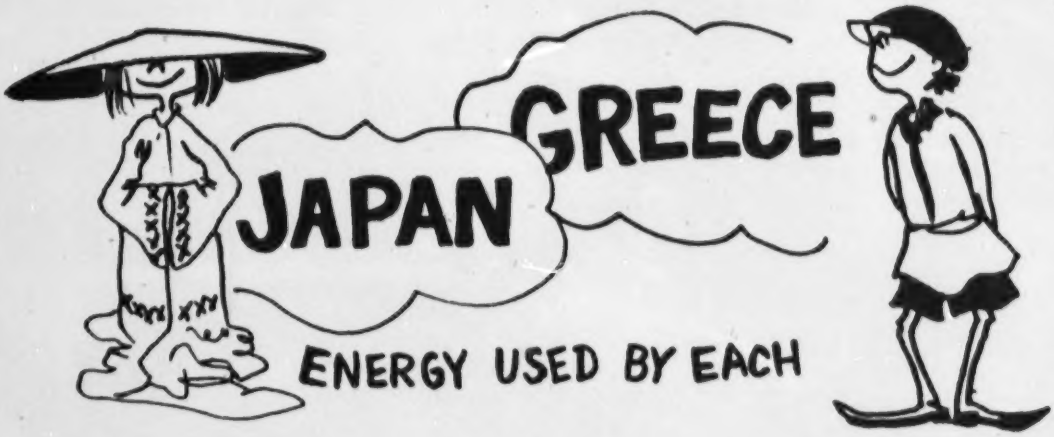
concept: V - Every decision made involving energy affects standards of living.

uses

objective: B - The student will understand the relationship between standard of living and energy use.

activities

1. Compare the energy uses of developed and underdeveloped countries.
2. Refer to tables describing average annual income, energy consumption, and population. Calculate averages if all nations are grouped, if Common Market countries are grouped, if underdeveloped nations are grouped, etc.
3. Investigate the use of energy by a child in Japan and one in Greece. Is there a difference? Explain. Is there any correlation with population or population growth?
4. Calculate the amount of energy each world individual would receive per day if the daily energy consumption were divided evenly. Compare this with the amount now being used. How could each individual alter his energy use to bring himself into balance?
5. List in order, your uses of electricity from necessary to unnecessary. Describe your living conditions without various uses of energy. Develop a scale from a level where you are unable to survive to a level of ultimate luxury.
6. Discuss whether happiness is equated with energy - considering luxuries. What would you be willing to give up right now? Contrast the enjoyment of a bicycle to compulsory exercise classes.



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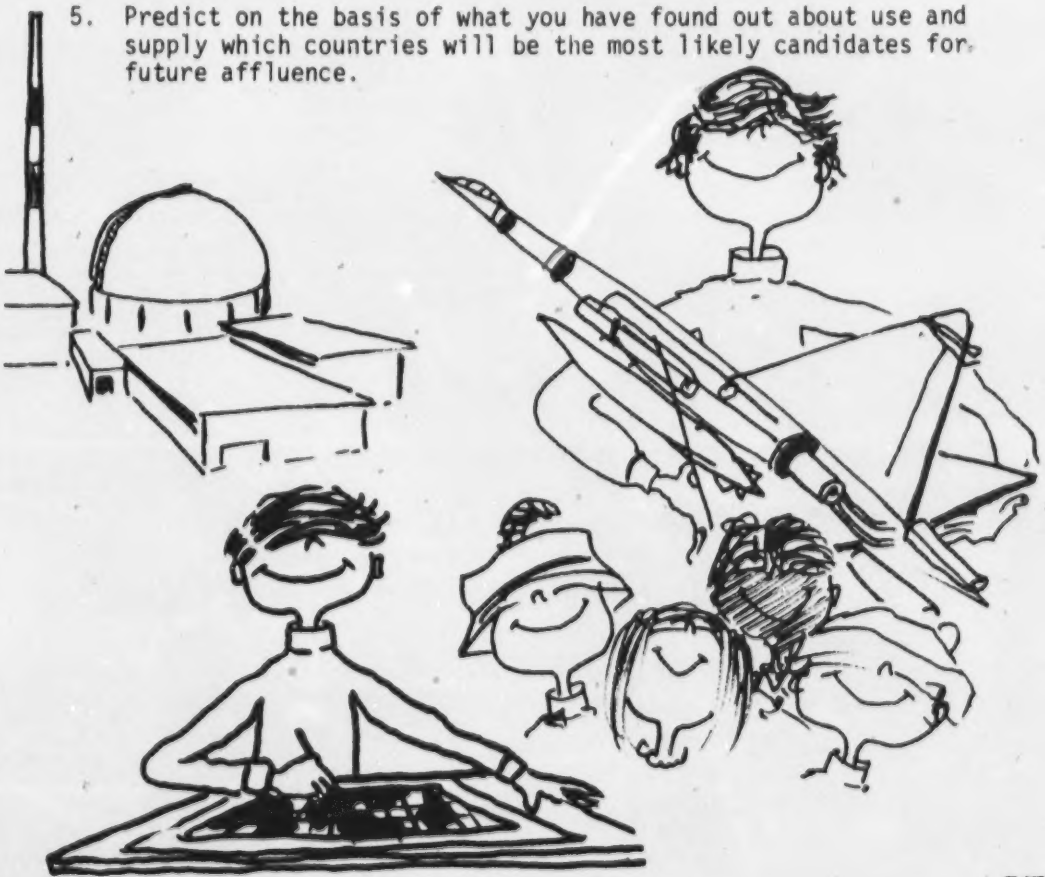
concept: V - Every decision made involving energy affects standards of living.

uses

objective: C - The student will know which of the world's countries fall into the have and have-nots and how/why the categorizations have changed over time.

activities

1. On a world map, locate important energy fuels and major energy users.
2. Based on current statistics, contrast the energy mix of a highly developed country such as the United States with the energy mix of an underdeveloped country. Investigate the amount of energy available in that underdeveloped country as compared to the U.S.
3. List the world's countries by continent and determine the geographic positions with reference to the world's energy supplies.
4. Locate on a map the countries that have large energy resources and compare them with those that use large amounts of energy.
5. Predict on the basis of what you have found out about use and supply which countries will be the most likely candidates for future affluence.



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concept: V - Every decision made involving energy affects standards of living.

uses

objective: D - The student will know the advantages which the people of a high standard of living country have over the people of a low standard of living country and the role that energy plays in contributing to the inequality.

activities

1. List all the "energy users" that you personally own or use, such as radios, toys, appliances, etc. In the list, state the type of energy required, such as AC power battery, wind-up spring, etc. After completing the list, compare it with the items you might own in a nation which uses less energy such as India. Try to list the "energy users" the Indian child might use.

2. Compare the life style of an underdeveloped society with your life style. Consider the energy consumed, and discuss the difference.

3. Compare the standards of living of five different nations in terms of energy use. One way to do this would be to write a daily journal of a student or farmer in each of these countries.

4. List the ethical implications when one social group uses twenty-five times as much of an unrenewable resource as another social group.

5. List those characteristics that distinguish a high standard of living from a low standard of living, or write an essay which describes and defines the differences between high and low standards of living.

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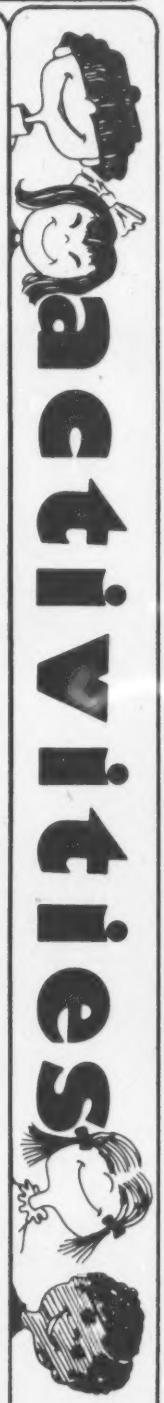
concept: V - Every decision made involving energy affects standards of living.

uses

objective: E - The student will know energy choices man might make which would have trade-offs involved and be able to defend the choice on the basis of the trade-off created.



1. Explain why the status quo cannot be maintained in the consumption of power around the world. What share of energy requirements should Americans use - 35%?

2. Using small groups, discuss "trade-offs" which must be considered before constructing the following:

   a. a geothermal generating plant
   b. a nuclear generating plant
   c. a hydroelectric generating plant
   d. a fossil fuel generating plant

3. Evaluate the benefits to mankind derived from nuclear power generation. Also evaluate the harm which might result from nuclear power generation, including problems of nuclear waste disposal.

4. Given the cost of underground wiring versus the cost and maintenance of power poles, explain how a community might justify the cost of underground wiring.

5. List five different electric appliances used in your home that the family could most easily live without. State reasons for each of the decisions and describe what effect this would have on your family.

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concept: V - Every decision made involving energy affects standards of living.

uses

objective: F - The student will know how social pressures to have things and use energy are created.

activities

1. Interview your parents concerning who makes the decisions about the purchase of major electric appliances. Ask what influences their selection of brand, size, and model. Ask whether the amount of electricity required is considered.

2. List the electrical appliances in your home in the order of their importance. List separately the ones you feel could be eliminated without lowering this "quality of existence."

3. Analyze television commercials for one week to determine procedures used to influence people to purchase advertised items. Do the same for magazines, newspapers, and billboards. Are the items shown necessary or desirable to own?

4. List ten things for which man now uses labor-saving devices that he once did for himself. Speculate on how the need to own an electric toothbrush was created.

5. Write an essay on why it is important or unimportant that your family "keep up with the Joneses," and show how energy contributes to this pressure.

6. Design a product and mount an advertising campaign designed to create a "need" for the product.

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concept: V - Every decision made involving energy affects standards of living.

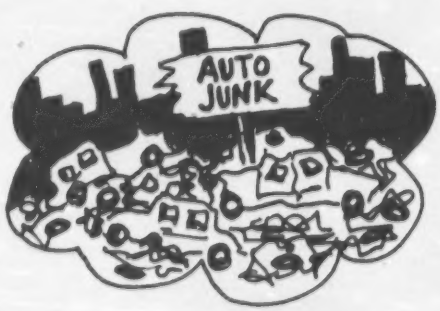
uses

objective: G - The student will know that planned obsolescence exists and is not in the best interest of society.

activities

1. Make a collage of magazine advertisements showing objects that have a very short use life.
2. Contact the Better Business Bureau in your community to determine the extent of complaints involving poor workmanship and repair work.
3. Make an inventory of objects in your home that no longer function and determine with your parents' help the average life expectancy of various items.
4. Attend an auction and determine what kinds of objects are being sold.
5. Visit the local automobile junk yard and count the number of various kinds of automobiles. Chart the results.
6. Make an inventory of every item in your home that costs more than $50.00 and has been in your home for at least five years.

   Make a similar list for those items that have been discarded in the last five years.



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concept: V - Every decision made involving energy affects standards of living.

uses

objective: H - The student will know the concept of affluence and understand that its definition is peculiar to a given culture at a given time.

activities

1. Make two murals contrasting the energy sources used to construct the great pyramid and the Aswan Dam.

2. Research how monetary systems have changed over time. Produce a poster which depicts work done by various workers in relation to the rewards each receives for that work.

3. Depict means by which ancient civilizations exhibited affluence and relate the energy required to produce this affluence.

4. Using the Agricultural Almanac or U.S. Statistics, compare total protein consumption by country with gross national product.

   Compare: Mexico - U.S.A.
   India - West Germany

   Also compare protein consumption with fertilizer usage.

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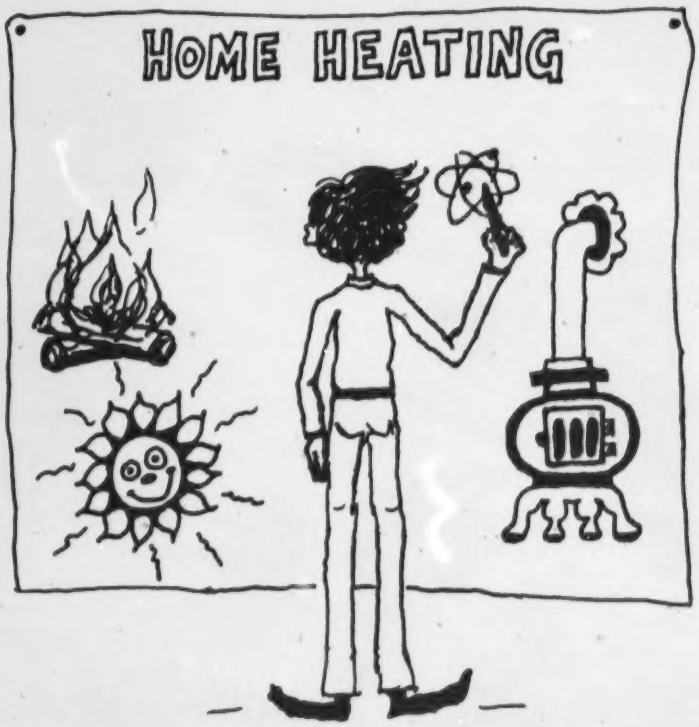
concept: V - Every decision made involving energy affects standards of living.

uses

objective: I - The student will know the various percentages of total energy use that each energy source provides and how those percentages have changed over time.

activities

1. Draw a mural depicting the major means of heating homes in the year 1850, 1950, 2050.
2. Write your regional Federal Energy Commission office and ask for figures on the percentage of energy use supplied by each energy source and how those percentages have changed over time.
3. Invite a local grandmother or grandfather to the classroom to discuss how energy use has changed during his or her lifetime.
4. Obtain a number of old magazines and new magazines. Compare the different energy uses portrayed in each.



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concept: VI - Social, economic and political pressures influence the efficient and economical use of energy.

uses

objective: A - The student will understand that governments establish regulatory controls which are designed to control energy use and pollution.

activities

1. To conserve gasoline, a decision has been made to reduce the number of automobiles in this country. Draft a set of priorities and regulations to accomplish this as fairly as possible for all citizens.

2. Should limitations be placed on uses of energy, land and natural processed resources? What should those limitations be? What type of agency should have that regulatory power? Draft a proposal which deals with ways to cope with these problems. Secure class agreement with it.

3. Describe the political or private group which you think should control energy production.

4. Role play various pressure groups (lobbyists) attempting to influence a state legislature to regulate, or not regulate, an energy source, (e.g. a new coal mine or power plant). Include business, labor, environmental and local interest groups.

5. Survey the local neighborhood to determine the number of people who have boycotted the purchase of consumer goods in the past. List the reasons given. List the products boycotted.

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concept: VI - Social, economic and political pressures influence the efficient and economical use of energy.

uses

objective: B - The student will realize that individuals may band together in citizen groups to effect political/social/economic choice.

activities

1. Write for information concerning energy from the following organizations:

Sierra Club	American Manufacturing Association
Wilderness Society	American Petroleum Institute
OPEC	Con Edison
U.S. Chamber of Commerce	Electric Power Research Institute
Audubon Society	Zero Population Growth
Friends of the Earth	Ralph Nader
Common Cause	Wide Earth Society

2. Compare the positions taken by two or more of these groups concerning a given controversy, i.e. Alaskan pipeline or breeder reactors.

3. Using news microfilm of energy company advertisements compare the political/social/economic impact on energy use as illustrated by Reddy Kilowatt in the late 1960's and Colonel Watt in 1974-75.

4. After a visit to your local county government or city council meeting, graphically explain the process by which a concerned citizen gets his energy concerns discussed by local decision makers. Who must one see to get things considered?

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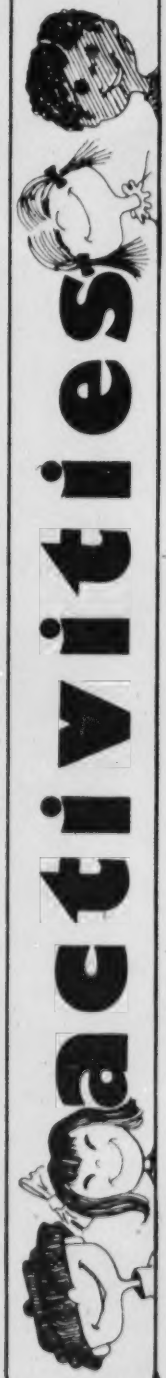
concept: VI - Social, economic and political pressures influence the efficient and economical use of energy.

uses

objective: C - The student will understand economic, political and social pressures which have been used to encourage the efficient and economical use of energy.

activities



1. Write a description of each member of an idealized five member panel that must make ultimate decisions about the control of energy production. Include data that reveals:

   a. political affinity
   b. educational background
   c. vocational background
   d. ethical standards, etc.

   Make character cartoon-like puppets for each of the five panel members mentioned above.

   Write a puppet play in which these characters decide an energy issue. Perform the play for an appropriate group or video tape it.

2. Hold a class debate on these questions: Should an automobile driver drive less because of the rising cost of gasoline? What should he do? What can he do? If he has the money, should the auto owner be able to buy as much gasoline as he wishes?

3. Collect and display political cartoons that illustrate responses of government to energy conservation measures.

4. See the Congressional Information Service in the reference section of a major library and extract testimony regarding some energy legislation. Then assign roles and simulate the process of decision-making.

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concept: VI - Social, economic and political pressures influence the efficient and economical use of energy.

uses

objective: D - The student will understand that various governments have passed legislation which has affected the development and conservation of energy resources.

activities

1. Find out what regulations exist in your state concerning the use of snowmobiles, trail bikes and/or sand dune vehicles. Discuss in class whether or not the use of these vehicles can be justified on the basis of their energy use and environmental impact. Write an essay exploring and supporting a position for or against using one of these vehicles.

2. Invite the mayor or city councilman of your town to your classroom to discuss any city regulations concerning energy use. Write your state legislator asking him the same questions. Include a request for the names and addresses of any state regulatory agencies.

3. Write to your congressman to determine his stand on significant energy conservation legislation and report to the class.

4. Determine how the federal fuel allocation system has affected industries in your state. Report on the transportation, power, timber and tourist industries.

5. Collect and display advertisements illustrating methods that industry has used to implement energy conservation policies.

6. Set up a class discussion in which members of the class debate the various administrative and congressional measures designed to meet the energy crisis.

CONSERVE HEAT — INSULATE!
TURN OFF LIGHTS WHEN NOT IN USE!
KEEP YOUR THERMOSTAT SET LOW!
RIDE YOUR BIKE — OR WALK!
WRITE YOUR CONGRESSMAN

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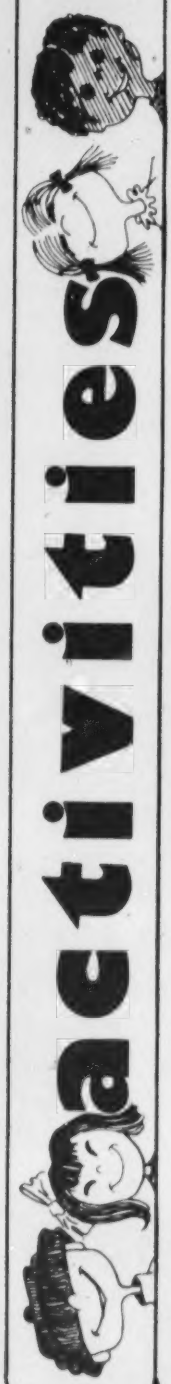
concept: VI - Social, economic and political pressures influence the efficient and economical use of energy.

uses

objective: E - The student will understand that power balance shifts among countries often hinge on energy issues and concerns.



activities

1. Write a story describing the world power balance in the year 2000.

2. Collect a series of cartoons depicting the shift in power balance brought about by the energy crisis.

3. Print and distribute 500 bumper stickers entitled "The Meek Don't Want It."

4. On a map locate the countries that held the reins of power in 3000 B.C., 600 B.C., 300 A.D., 800 A.D., 1100 A.D., 1500 A.D., 1890 A.D., and at present.

   Chart the use of energy during these periods and predict the countries that will hold the power in 2000 A.D.

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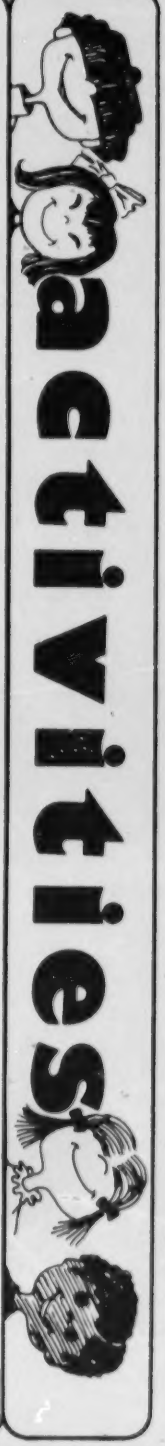
concept: VII - There are many ways to conserve energy.

uses

objective: A - The student will know numerous ways by which energy may be conserved at home, at school, and in the broader community.



1. Compare utility bills from several different households to discover why one family may use more kilowatt-hours than does another.

2. Save all packaging materials from your family's goods for a period of one day. Suggest alternative packaging methods for as many items as possible, considering the following:

   a. biodegradability
   b. efficiency of product use
   c. aesthetics

3. Check with a local utility to determine the number of Kwh used in October of the year before. Ask your family to conserve electricity by all means possible for the month of October. Compare the Kwh used for October of each year to determine the amount of savings. Provide for the variables of degree days, added energy-using devices during the year, and daylight intensity.

4. List ways in which energy consumption can be reduced without decreasing the quality of life.

5. Pretend your school is a modern one with large windows, plenty of overhead lights, and is even air conditioned. Everything seems to be going along very nicely until one day an area-wide power shortage is announced. Plan for this reduction of the use of electrical energy in the school. What alternatives can be suggested? What reasons support and oppose each alternative?

6. An ordinance has been passed ordering all users of electric energy to reduce their use by one-half. Explain what you will choose to do without and why.

7. Record at least ten ways in which energy is used in your school.

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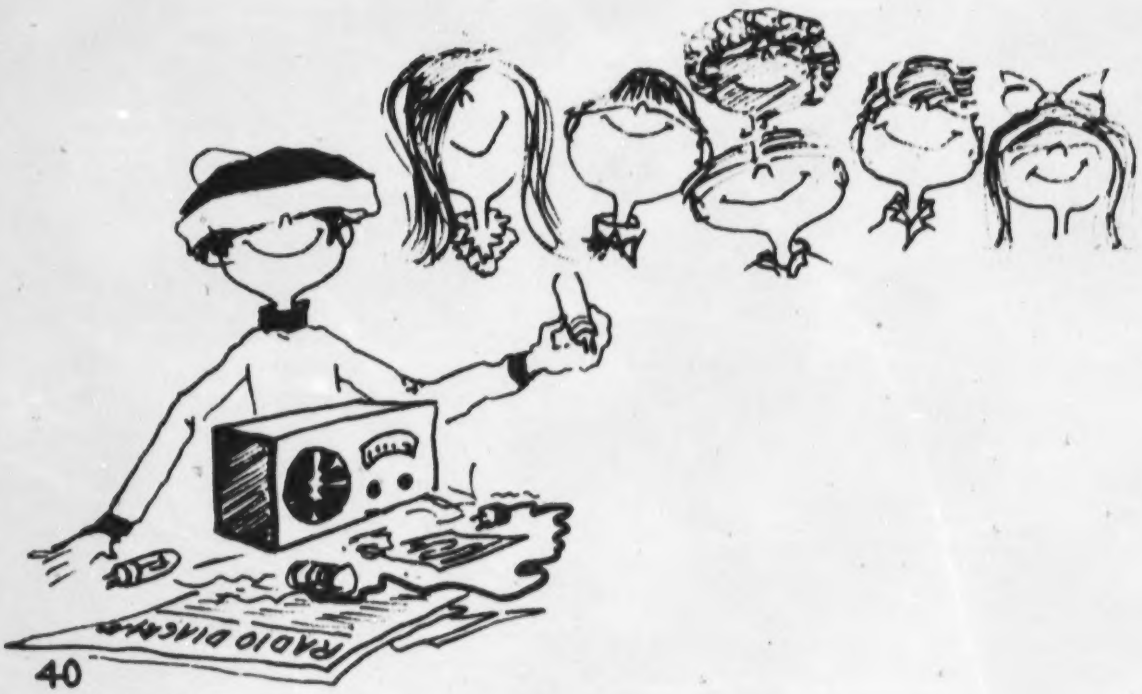
activities

Concept VII
Objective A

8. Calculate the electric energy that might be saved in one year if your home were to discontinue using each of the following electric appliances:

   a. toothbrush
   b. toaster
   c. hot water heater
   d. freezer
   e. lights - incandescent and fluorescent
   f. resistance electric heating
   g. air conditioning
   h. radio
   i. television
   j. range
   k. dishwasher
   l. rotisserie
   m. radar range (microwave oven)

9. Conduct a survey of an assigned area in your community using the survey form on the next page. Organize others to help you analyze and present the results to others in your class or school.



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activities

Concept VII
Objective A

SURVEY: "HOW IS YOUR COMMUNITY RESPONDING?"

YES	NO	UNDECIDED

a. Are wastes treated?

b. Does your community have a waste treatment plant?

c. Is your waste-treatment plant primary?

d. Is your waste-treatment plant secondary?

e. Is your waste-treatment plant tertiary?

f. Do industries dump their wastes into the community treatment plant?

g. Do industries bypass your community's waste-treatment plant and dump their wastes into local water sources?

h. Do industries dump their untreated wastes into local water sources?

i. Do homeowners dump their untreated wastes into local water sources?

j. Do businesses dump their untreated wastes into local water sources?

k. Is some waste bypassed into local water sources during normal dry weather?
   a. What % _____
   b. How often _____

l. In wet weather, when lines and plants may be taxed by storm flow, is some sewage bypassed into local water sources?
   a. What % _____
   b. How often _____

m. Does your waste-treatment plant have enough employees to operate it efficiently on a 365-day basis?

n. Does your waste treatment plant have enough employees to operate it efficiently on a 24-hour basis?

o. Is a training program provided for waste-treatment operators in your community?

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activities

Concept VII
Objective A

YES	NO	UNDECIDED

p. Does your waste treatment plant provide on-the-job training?

q. Is your training program paid for by the community?

r. Is your treatment plant up to date?

s. Does your community require connection to a public waste treatment plant?
   a. How many sewer pipes are not connected with a waste treatment plant?_____

t. Does your community prohibit its sewer system to be connected with storm water drains?

u. Does your community have a sewage treatment problem?

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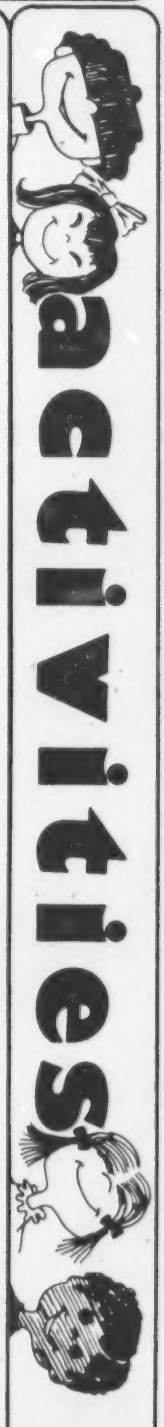
concept: VII - There are many ways to conserve energy.

uses

objective: B - The student will understand that some energy conservation practices may be more economical than others.



1. Investigate the apparent excessive use of lighting in commercial buildings at night and compare use with need.

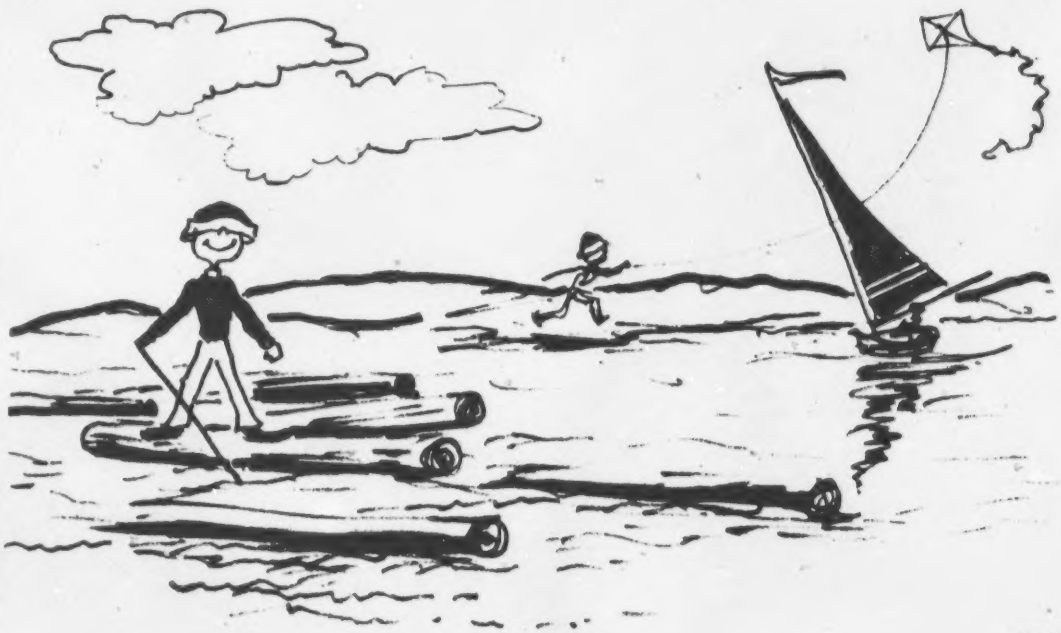
2. If you live near a rapid-transit system, such as the Monorail in Seattle, go for a ride on it. Write a paper comparing costs of rapid-transit to an automobile.

3. List energy sources that are used without conversion, such as:

   a. floating logs down a stream
   b. flying a kite
   c. sailboats

4. Should each home deliberately diversify sources of energy, e.g. use gas, electricity, wood in fireplace, oil, etc.? Will this save on costs of fuels? Write an editorial expressing your opinions.

5. Read the September 1974 Scientific American article on population and food supply. Graph the caloric input per unit of output for different agricultural techniques in the U.S., and contrast them with techniques and practices in other countries.



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concept: VII - There are many ways to conserve energy.

uses

objective: C - The student will know alternate strategies which may be employed by industry to conserve energy.

activities

1. Visit a sanitary landfill project in the area and list five items that might have been recycled, reused or burned to produce heat.

2. Visit a bottling plant and find out what the company is doing about recycling. Discuss methods and costs of recycling in contrast to throw-away containers.

3. List ways of using to advantage the waste heat produced by power-generating plants.

4. Design and make drawings of a system that could use waste to heat and cool office buildings in your city. Assume the system will burn 360 tons a day of solid waste and allow for future expansion to burn 1500 tons a day.

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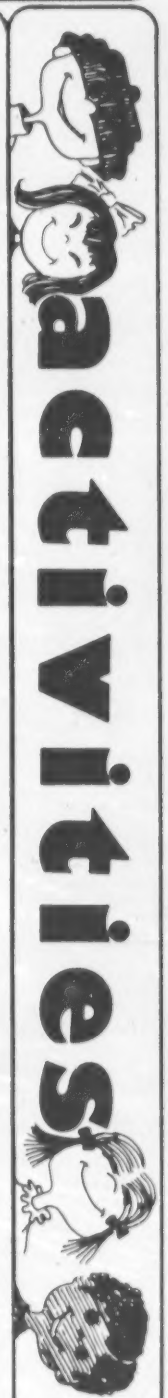
concept: VII - There are many ways to conserve energy.

uses

objective: D - The student will note that industries and governments develop alternative strategies through a process of research and development.



1. List the major industries in your community. Write letters asking them to describe their approach to energy conservation.

2. Visit a local industry and survey the extent of its energy conservation techniques.

3. Set up a model Research and Development group in your classroom to determine procedures to conserve energy in your school.

4. Invite someone from a local industry's Research and Development department to visit your class to discuss alternate strategies for energy consumption in his industry.

5. Research in your library the Research and Development activities that went into development of the following:

   a. light bulb
   b. steam engine
   c. space satellite
   d. internal combustion engine

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